The Case for Anode Baskets

How easy is it to convert from anode bars to anode baskets? What is involved?...

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Converting from copper bar anodes to baskets of copper anodes can improve the economy, efficiency and quality of the electroplating process. There may be restrictions, and it does require a bit of effort, patience and up-front investment. However, the rewards materialize immediately and increase later.

More productive plating is one compelling economical incentive. Others include lower anode cost and more efficient copper use. There are fewer maintenance shutdowns and less frequent sludge removal.

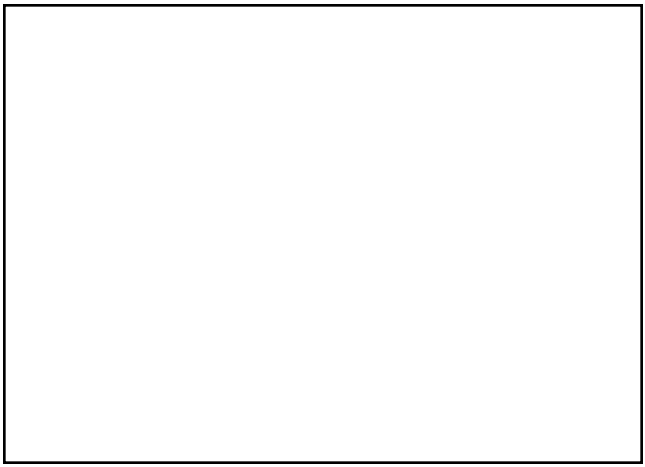
Any number of applications is feasible, including plating metals, plastics or electronic components in continuous operations or batch processes.

Copper nuggets and ball-shaped anodes are abundant. An oval cross section is most common, ranging in size from 1.5 to three inches. Rectangular shapes are also used, depending on the application and plating-line design.

Nuggets are produced from copper rod of various diameters. They are chopped into different lengths. Sizes typically range in diameter from 5/16 to two inches and lengths from one-half to two inches.

Ball-shaped anodes have been used increasingly over the past ten years, particularly in mechanical systems that automatically replenish spent anodes. They also have gained popularity by minimizing the labor needed in manual operations.

Metal strip plating. One application is continuous copper plating over metal strip. The continuity of the operation accentuates some key ben-



1. METAL strip plating line

efits: frequent anode replenishment (even with automatic, mechanical feeder rails), constant anode surface, downtime necessitated only by bath and sludge removal.

For example. Let's assume a two-tank system is used to plate the strip on one side. Fed on rollers, the incoming metal strip first enters a strike zone. The strip fully exits this zone and continues through a two-part plating tank.

The electrical power rating of the strike tank is 2,000 amps, but is operated with about 850 amps at each of two crossbars. Twenty bar anodes, each equipped with titanium hooks, are rated for 50 amps. They hang with virtually no lateral spacing at either end of the strike zone tank. In the plating tank, each of four crossbars of bar anodes is rated at 1,500 amps, with a maximum power capacity of 6,000 amps. Each conductor rod holds 22 bars, also without material spacing, with hooks rated for 50 amps.

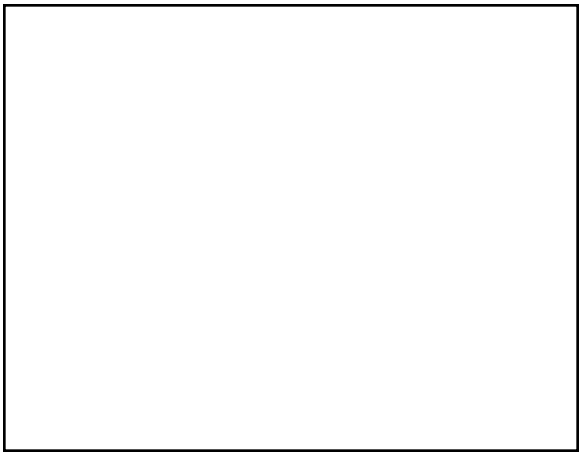
All anodes are rectangular two-by-three-inch cross sections, 65-inches long. The electrolyte is an acid copper bath.

Conversion. The mission is to replace the anode bars with baskets, but leave the rest of the plating line intact. The initial concern is to match anode surface areas so that the plated deposit will not change.

A central calculation helps determine how many baskets and what size and shape are required. The calculation will take into account factors such as the number of rods in use, cross-section measures and lengths, proximity of the bars and current concentration.

Several empirically derived "rules of thumb" work well to optimize the conversion. The baskets should be at least as long as the bars. The front surface area should equal the front plus one side of the bars, since the sides of the baskets are solid and ions only flow through the front mesh. Baskets should be easy to handle and replenish. The standard six-inch wide by 2.5-inch deep cross section is commonly used.

Each sq inch of mesh yields more copper surface than the flat bar surface. The converted application will



COPPER nuggets and balls

use fewer baskets than bars to achieve an equally functional surface area of copper. A rule of thumb suggests that the combined front surface area of the baskets across a conductor bar should be 30 pct smaller than the combined area of the front side of the bars.

The criteria in this particular case results in the following basket system specifications. In the strike zone, 22 titanium baskets are used to match the ionized copper level of the 40 rods.

The 20 three-inch-wide by two-inch-deep and 65-inch-long bars have 6,500 sq inches of surface area. The effective basket replacement area should be about 30 pct smaller, or 4,450 sq inches. Each basket has a front surface of 6 x 65 = 390 sq inches. This means 11 baskets are needed on each of the two crossbars.

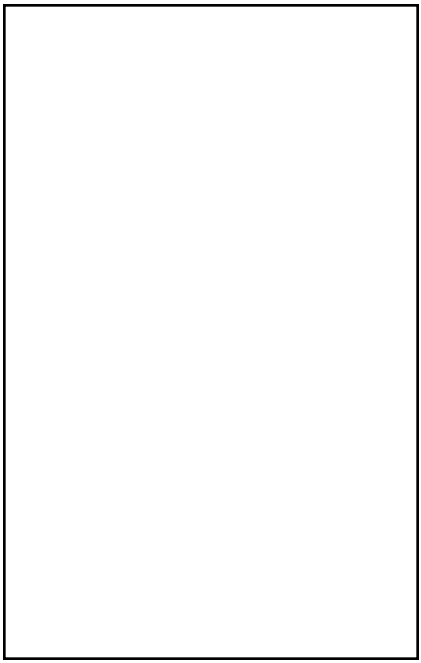
Across the conductor rod, the baskets should be at least one to 4.5 inches apart or more. They should never touch. It is essential that the hooks are thick enough to carry the needed current. Titanium is a poor electrical conductor and if not properly sized could turn red and straighten.

Economics. Bars typically cost about 10 pct more than nuggets. Let us assume that this plant consumes about 5,000 lb of copper a month, and the bar-shaped anodes were purchased for $1.85 per lb. The annual purchase cost for the copper rods has been 5,000 ∞ 12 ∞ $1.85 = $111,100. At a 10 pct lower price, nuggets would reduce the annual purchase cost by $11,000.

Not all of the bar material is consumed in the plating process. Although the work may be distributed evenly, the plating process does not deplete the copper evenly along the length of the rod. There is typically less erosion in the vicinity of the hook than at the opposite end. In time, this produces a spear-shape that needs replacing. Typically, bars are replaced when about 15 pct of the copper material remains.

Bars also hang from hooks in such a way that not all of the copper material is fully immersed in the plating bath. Inevitably, there will be unused material at the top.

In basket operations, copper material is fully submerged and all of the material is consumed. As it "dis-



PLATING BASKETS for holding nugget and ball-shaped anodes

solves," the baskets are replenished, leaving no scrap material.

Selling the unused bar material back to a copper distributor as scrap recovers some of the value of the original metal, but the unused copper still represents a sizable cost. A typical scrap return of $1.30 per lb still produces a scrap cost of 55 cents per lb, not taking into account the costs related to handling, transportation and disposal. At the assumed consumption level, this represents an annual scrap cost of $4,950.

The principal initial cost of the conversion will be for the baskets themselves. However, baskets can be capitalized and depreciated over a longer period of time. Baskets should last about 15 years in continuous, normal use.

Efficiency. Because the copper surface is maintained when nuggets or balls are used, consistently high plating speeds can be maintained. Also, the plating rate is not decreased at the rate of the depletion, therefore plating runs can be longer.

Anode baskets are inspected readily, limiting labor and downtime. Usually what is on the top is also on the bottom, although sometimes shaking the baskets may be advantageous to ensure that nuggets have not become trapped in the basket.

Basket options. Titanium plating baskets are preferred in nickel and acid copper baths because they do not corrode. They are typically sand blasted and/or wire brushed to a smooth surface to ensure that the bags retain contaminants, and the anodes are not damaged during installation or removal. They are equipped with hooks that are "A"-shaped for round bus bars or "C"-shaped for bus bars with rectangular cross sections.

Often, rectangular cross sections are used for copper plating, usually ranging from one to three inches thick and three to 12 inches wide and 12 to 48 inches long. They are constructed with solid sides and fine, medium or coarse diamond-shaped mesh on the front and back. In many cases, the mesh, which may come in two or more wire gauges, is mounted with the diamonds vertical in order to minimize the possibility that the metal in the baskets becomes trapped.

What chemical purity, shape and size anodes are ideal? Contaminant levels vary between manufacturers, mostly as a result of raw materials used (scrap or pure virgin cathode), melting process (open hearth or under oxygen-free atmosphere) and quality control facilities and procedures. Whether nugget or ball-shaped anodes are used is often determined by whether manual or automatic feed is employed. Size is determined by plating specifications.

Other considerations. Conversion may require a week or two of downtime. A few days of fine tuning will allow operators to eventually duplicate the original plating characteristics.

If tests run after the basket installation indicate too heavy copper transfer, reduce the amount of copper in the baskets (an inch or two). If the copper level remains too high, liquid composition and temperature may be adjusted instead of further separating the baskets. It is usually not useful to modify the current concentration.

There are situations where conversions are not feasible because they would require prohibitive changes in the plating line. Space constraints can be one. Lines using bars typically have been operating a long time and were designed specifically for bar applications.

The "work" may come too close to the basket, which could cause burning and other complications that would diminish the plating quality or change the desired plating characteristics. Most baskets are 2.5- to three-inches thick, but in many applications may be held to two or even one inch.

There may not be room for operators to get into position to replenish baskets safely and conveniently without changing the arrangement of the tank. Automatic feeding systems may be implemented, including overhead feeding mechanisms.

Unusual plating setups may also be an impediment. Sometimes the plating flow does not move horizontally, but vertically, or in other directions. This may preclude the use of baskets. In some multi-tank applications, a combination of bars and baskets can be used.

There are obvious and compelling economic and operating incentives to consider when converting from bar-shaped copper anodes to baskets with nuggets or spheres. Reduced anode cost is, perhaps, the most important benefit. Barring major changes in the plating line, savings here will recover the cost of the conversion quickly. After that, the plater continuously stands to benefit from significant savings in anode cost and scrap, improved operating efficiency, higher quality and reduced downtime and hazardous waste removal. **PF**